

XV. *New light on the formation of the abdominal pouch in Parnassius.* By SAMUEL H. SCUDDER, F.E.S., of Cambridge, Mass., United States.

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CAPTAIN ELWES, in a paper on the genus *Parnassius* (Proc. Zool. Soc. Lond., 1886, 6—53, pl. 1—4), has based his classification of the species largely on the structure of the abdominal pouch of the female, and given a very interesting and useful *résumé* of what was known with regard to its formation. From this, and the new observations by Thomson and Howes given in his paper, as well as from some notes of his own, it would appear to be the general conclusion that the abdominal pouch seen on the under surface of the subterminal segments of the abdomen of the female of *Parnassius* is not present when the butterfly emerges from the chrysalis, but is constructed during the prolonged pairing of the sexes by a secretion formed at the time, and which hardens into a definite form, varying according to the species. Whether this secretion proceeds from the body of the male or of the female, and by what means it takes on its definite shape, there is more variance of opinion, but the weight of testimony appears to be in favour of regarding it as formed by the male, and moulded upon the shape of the terminal segments of his abdomen. Siebold, who was the first, more than forty years ago, to make scientific observations on this point, believed that the secretion was poured out from under the two lateral valves of the male (*ergiesse sich . . . das gerinnende Secret unter die beiden seitlichen Klappen*), by which he means the expanded and prolonged side pieces of the eighth abdominal segment.

My attention was specially directed to this matter by the field observations of Mr. David Bruce in Colorado, communicated to me by Mr. William H. Edwards, who asked me to verify and explain the same by dissection of the male abdomen. Mr. Bruce, whose interesting

observations will be detailed in full in Part xiv. of the current series of Mr. Edwards's 'Butterflies of North America,' reported that during the mating of the sexes in *Parnassius smintheus* he saw a "scimitar-like" organ working *beneath* the membrane which formed the pouch, and apparently moulding the same from the interior into the definite shape which it assumes; and this organ, which he believed to be no part of the genitalia proper, worked with a piston-like action in each division of the pouch, which yielded to its motion. This would seem to be directly opposed to Mr. Thomson's statement regarding the formation of the pouch in *P. apollo*, as given by Capt. Elwes (*l. c.*, p. 13), for he describes a membranous sheet attached to the male body containing a green fluid, covering the female pouch on the *outside*, and forming a "mould in which the pouch is formed during copulation."

Mr. Edwards having placed in my hands abundant dry material during the past winter, I soon reached a conclusion which seemed to throw some new light upon the matter, and perhaps to reconcile the apparently contradictory statements of the two observers mentioned. My dissections were almost entirely of specimens of *P. smintheus*, but, as they left many points still unexplained, I was anxious to examine living examples, which alone could furnish an answer, and verify or disprove my conclusions. At Mr. Edwards's solicitation, therefore, Mr. Bruce sent me last spring on several occasions living males of *P. smintheus* from Colorado, and Mr. Wright one lot of living males of *P. clodius* from California. Unfortunately none reached me alive, excepting a single moribund example of *C. smintheus*, too far gone to be useful; and since the failure of this experiment leaves it improbable that an opportunity for my examination of a living male *Parnassius* will soon occur, I venture to publish my observations in the hope that some one more favoured by position will be moved to further investigation.

The structure of the abdomen of the male *Parnassius* is remarkable for having, as in the Euploëid genus *Anosia*, the sides of the eighth segment expanded and posteriorly extended, forming a kind of false claspers concealing the greater part of the genitalia proper; in *P. smintheus* and *P. apollo* embracing also the inferior

surface of the true claspers, and thus here giving to the eighth segment a length twice as great along the ventral as along the dorsal region. It is beneath these "Klappen," or false claspers, that von Siebold says the secretion is poured forth; and he is certainly right, for all the crevices existing between the inner surface of these expansions and the outer surface of the organs beneath, which it closely clasps, are often filled completely, in all specimens I have examined to some extent, with a coagulated secretion, which, when compared under the microscope with a fragment from the pouch of the female, is of essentially the same character as it.

In *S. clodius*, *S. mnemosyne*, and other species, the false claspers do not embrace the under surface of the true claspers, which are thus not at all concealed on an inferior view, and therefore there is in these species considerable modification of the parts I am about to describe, in remarks which are based wholly upon an examination of *P. smintheus*.

If the eighth abdominal ring is carefully removed bit by bit (which can hardly be done without rupturing some of the coagulated secretion, but often leaves broad sheets intact), all the accessory organs of generation are exposed to view; it will then be seen that the sternal portion of the ninth segment (the segment to which are attached the claspers proper) is split along the median line, and sends two anterior shafts side by side to the hindmost edge of the overlapping eighth segment. Directly beneath it, beneath in the sense of towards the middle line of the body, *i. e.*, lying between the lower anterior ensiform process of the ninth segment and the lower surface of the true claspers, is a pair of lamellate scimitar-shaped organs diverging at tip, and so closely connected with the sheet of coagulated secretion, and of so nearly the same colour and texture as it, as to appear a part of the same. It is only when the processes of the ninth segment are in their turn removed that the form and structure of these parts can be made out; it is then seen that they have a membranous or tendonous structure, hardly chitinous, and certainly not the same as the hardened, jelly-like, structureless condition of the secretion, which is continuous with their edges, and permeates the crevices in the region about. By uncovering the parts in front, *i. e.*, toward the base of the

abdomen, it is seen to be formed mainly of two slender blades, curving in opposite senses, which lie under the protection of the anterior processes of the ninth segment, but, when they pass forward, dilate into triangular expansions which nearly fill the lozenge-shaped space left vacant between the curved base of the anterior processes of the ninth segment (following the similar curve of the eighth segment) and the slightly emarginate apex of the seventh; at their base they appear to be attachments of the seventh segment; the opposite sides of the triangular basal expansion are thicker than the middle, as if there were a two-branched basal attachment connected by a slight membrane to give greater support and rigidity to the attachment.

This organ, which, so far as I know, has no homologue whatever among Lepidoptera, seems to lie in just the place and to be of just the form to serve as the apparatus for moulding on its interior the abdominal pouch of the female out of the secretions which flow either from it or through it or around it from glands in close connection with it; and consequently I suggest for it the name of peraplast (*πίρα, πλάσσω*), indicative of its use. The attachments and the mechanism by which it may act, together with the precise position and relation to it of the adjoining secretory glands, can of course only be told from fresh specimens; and fresh specimens would doubtless serve also to correct in some particulars this preliminary description. It will perhaps be found that the "membrane" mentioned by Thomson "containing a dark green fluid" is an evaginable gland extended from near the base of the false claspers (precisely as the evaginable pencil of bristles in *Anosia*), and that when it protrudes beyond their tip—as Thomson's description would seem to imply—it secretes from its inner surface the material of which the pouch is formed, which is then moulded into shape by the scimitar-shaped peraplast; this must have an extensile movement, surpassing even that of the true claspers. This is a point which only an examination, first of living males and next of pairs in union, can fully satisfy: and it will then remain for the histologist to scrutinise the organs themselves.

The problem still remains, to understand the purpose of the feminine pouch in *Parnassius*, and the homologous flaps in *Euryades*. Although they take on a definite

form, distinctive for each species, it has not only never been shown that they possess any function, but it is known that oviposition occurs without them, and they are apparently quite independent of that. Such extraordinary formations, moulded by the male upon the body of the female during pairing, and through the agency of special structures and special glands in the body of the male, cannot have arisen for anything but some most useful purpose. But for what?